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Disaster risk management indicators for cultural heritage in Taiwan

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There have been great advances in the concepts and application techniques of conservation since the entry of the 21st century. Value priority and the understanding of authenticity and integrity of heritages are becoming the most important issues of the conservation. Affected by this trend, the conservation of cultural heritage (CH) has rapidly developed into an interdisciplinary subject which requires integrating diverse disciplines. Risk management and public participation are among the most important issues of those disciplines.

Based on the collected information and evaluation, this research develops fire safety measures in heritage conservation. One is for the researchers to measure the risk of the heritage; the other is for the site managers to and manages the risk of their monument with ease.

In conclusion, most hazard indicators of CH can be mitigated mainly by management mechanism such as daily review, scheduled maintain and integrate with appropriated equipment. The cognition and execution of site managers is the key issue for the implementation of disaster management.

Key words: *Cultural Heritage, Disaster Risk Management, Taiwan*

1. Introduction

Risk management has been an important trend for the conservation of cultural heritage (CH) in recent years. However, the disaster prevention framework or tools researched by experts are somewhat difficult for the general public to understand. As a result, it causes problems in implementation. The establishment of an effective communication platform is a solution to this problem.

Compare with those modern buildings, monument has its weakness in the environment, materials, structure and not strong enough to prevent or against the disaster. In Taiwan, Cultural Heritage Preservation Act (CHA) had taken effect in 2006. The cultural value priority concept had been declared in the article 22 which guides to establish a proper risk management system and do not have to fit contemporize codes. This important idea had been realized in the field of conservation; however, there still has a gap in the implementation with firefighting department.

Under the influence of the UNESCO World Heritage strategy and the Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972, together with many relative international documents, the

concept and implementation of conservation has been taken the Outstanding Universal Value, OUV, as the most important issue and has been accepted as an international principle.

Besides that, the UNESCO, ICOMOS and ICCROM have released some important documents on the disaster risk management including its concept, identification, evaluation, mitigation, monitoring and resilience, etc. to help the conservation of CH. In 2012, took world heritage site Petra as an example, the UNESCO provided an experience on the evaluation frame and surveying indicators. 《Disaster risk management of cultural heritage in urban areas - A Training Guide》 by the ICCROM in 2014, was focused on the risk management and its training for the historic urban districts.

The Nara document in 1994 had high light the importance of authenticity and helping to under the value of cultural properties. Recently, under the influence of rapidly social change and the trend of globalization, a conservation concept based on the integrity, has been put into as a key issue to take care the environment of monuments and sites. This concept is not only concerning the protection of CH but also the development and risk management. Mainly are;

(a) The main purpose of the risk management plan is to protect the cultural value include the tangible and intangible evidences of authenticity, integrity away from the possible disasters.
(b) The knowledge of disaster history, science, techniques and implementation experiences which were carried by the CH together with their environment and supporting mechanism should be integrated into the risk management system and make their contribution.
(c) To establish a risk management mechanism is also a kind of cultural awareness as well and will achieve by a well plan and progressive action.
(d) The cultural diversity, capability of the community and their traditional should be considered in the risk management plan.
(e) All the stakeholders are the key members of the Plan.

In the experience of the conservation in Taiwan, mainly is focus on the restoration of the main construction of monuments and short of concerning the public participation and maintenance issues. Under this circumstance, it will not only squeeze the cycle for next restoration but also cause high risk on the monuments. Therefore established based on the integrity concept on the conservation and risk management can be more active in the preservation of CH, is essential to the meaning in Taiwan.

2. The disaster-causing characteristics of historic buildings in Taiwan

There are 2000 built heritages in Taiwan, includes 369 pure wood construction (18%) together with 878 wood and masonry construction (43%) which are in high risk.

Table 1 CH in Taiwan (2015.03)

Type	Number	Wood	Wood and masonry	others
Monument	806	140(17%)	239(30%)	427(53%)
Historic buildings	1182	227(19%)	261(22%)	694(59%)
Settlement	12	2(17%)	9(75%)	1(8%)
Total	2000	369(18%)	509(25%)	1122(57%)

According to the basic plan for disaster prevention and mitigation, disasters can be divided into two major categories of natural and anthropogenic. In natural disaster, typhoons, floods, earthquakes, fire are the most

significant (National Disaster Prevention and Response Committee, 2012).

The monuments affected by disaster in Taiwan for in the past 50 years, 77% was basically a fire, that is, the CH dominated by timber construction, resistance to fire is most vulnerable to a variety of major disasters such as floods, earthquakes, and human risks. For CH and settlement, fire caused by earthquake is still the greatest impact.

This research is mainly focused on the fire risks; provide easy tools for the identification of fire risk and management for the governments, professionals, site managers and communities.

3. The Main Concept of World Heritage

This research refer to the UNESCO and other international literatures and 《Risk management at Heritage Sites- A Case Study of the Petra World Heritage Site》 in 2012, in which the risk assessment was mainly based on the assessment and reduce the risk of CH and their collections by risk analysis criteria. In this proposal the systematic application of the risk management process (Figure 1) includes six steps:

(a) Defining the context and scope, including a documentation review as well as a values, condition and management context assessment.
(b) Identifying the risks.
(c) Assessing the impact of each risk.
(d) Identifying possible mitigation strategies.
(e) Evaluating risks and mitigation strategies based on cost–benefit analysis.
(f) Implementation of the strategies (preventively or actively) to treat risks.

There are also two permanent components of the risk management process: monitoring, and communication and consultation with the different stakeholders.

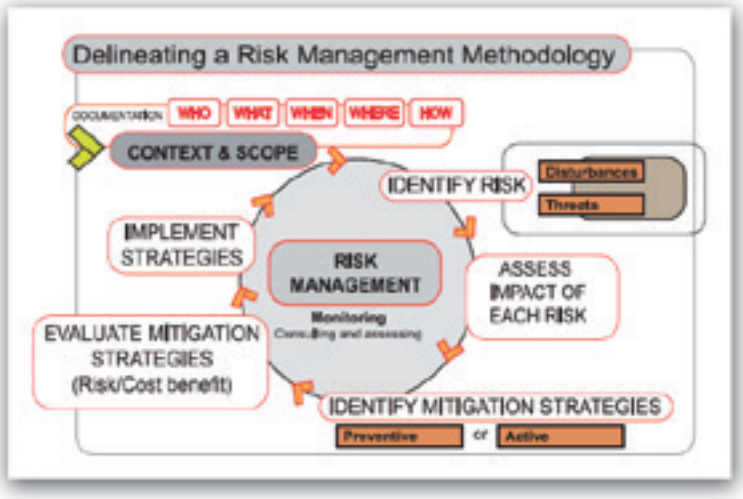

Fig1. A risk management approach (UNESCO,2012)

4. Hazard indicators Assess

First make on-site survey to investigate the characteristics and value of historical buildings and monuments together with possibility of internal and external spaces vulnerable to fire and fire-fighting equipment.

Secondly, identify each of the risks brought about by the disaster and management. Thirdly, the communication and consultation with stakeholders on the problems of hazard factors preventing to establish monuments hazard factor assessment indicators.

2011 to 2013, supported by the Bureau of Cultural Heritage, Ministry of Culture, and this research implemented “Professional services Centre for the conservation of CH, division (ii)". The scope of this project is to investigate 345~374 CH of 6 counties and cities in northern Taiwan. In 2014, another project on the investigating of 23 national monuments in the same region was implemented. Both projects are focused on the visiting their daily management, maintenance and analysis the disaster-causing factors, summary of the investigation to establish monuments hazard factor assessment indicators.

11 hazard indicators were analyzed in 2011 and added two more into 13 indicators in 2013. They are:

A. Management and Maintenance System
1) Disaster history.
2) Improper placement of items.
3) Undated environmental clean-up.
4) Excessive electrical facilities, overdue wire (including too many extension).
5) Management organization and lack of staff.
6) Failure in regularly attending relevant courses or lack of certificates

B. The external environment and the characteristics of the building
1) The use of fire.
2) Excessive electrical facilities, overdue wire (including too many extension)
3) Undated environmental clean-up.

C. Auxiliary fire-fighting equipment
1) Lack of appropriated fire-fighting equipment.
2) Lack of monitoring alarm equipment.

D. Patterns of buildings in use
1) Insufficient entrances (including those are often closed)
2) Others (to be repaired, etc.)

Table 2. 2011-12 Hazard indicators statistical chart

	1	2	3	4	5	6	7	8	9	10	11	12	13
2011（345）	Disaster history	Improper placement of items	The use of fire	Improper placement of items	Excessive electrical facilities, overdue wire (including too many extension)	Lack of fire-fighting equipment	Lack of monitoring alarm	Undated environmental clean-up	Management organization and lack of staff	Undated environmental clean-up	Others (to be repaired, etc.)		
CH	6	60	63	39	98	128	166	73	94	61	24	no	no
%	1%	7%	8%	5%	12%	16%	20%	9%	12%	7%	3%		
2012（362）	Disaster history	Improper placement f items	The use of fire	Improper placement of items	Excessive electrical facilities, lines of old (including extension cords)	Lack of fire-fighting equipment	Lack of monitoring alarm	Undated environmental clean-up	Management organization and lack of staff	Undated environmental clean-up	Others (to be repaired, etc.)	Failure in regularly attending relevant courses or lack of certificates	Insufficient entrances (including those are often closed)
CH	4	23	61	18	93	103	109	45	55	32	147	24	8
%	1%	3%	9%	3%	13%	14%	15%	6%	8%	4%	20%	3%	1%

The result of investigation of 345 CH in 2011 showed that excessive electrical facilities, overdue wire (including too many extension), lack of fire-fighting equipment, lack of monitoring alarm equipment are

most weakness of the CH and it leads to disasters to rescue and communications in real time. In addition, not enough number or lake of training of site managers are very common in private sites (Table 2).

362 CH had been investigated in 2012. The main hazard indicators were still the same as 2012. However, the percentage had obviously reduced due to the communication and training in the past year. The field observation, almost all the public CH has establish fire management and monitoring mechanism, as to private monuments due to lack of funding, it is difficult to improve the situation.

In 2014, continued the process established earlier, a four categories of 18 disaster indicators table was designed for this research to investigate 23 national CH. The field observation, 7 for government agencies to manage, have no significant hazard indicators, 5 of them have environment complex respectively vehicle larger and more difficult to rescue in case of disaster. The performance of private CH is not as good as the public (Table 3).

Table 3. 18 hazard indicators statistical chart for categories

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Disaster history	Improper placement of items	The use of fire	Improper placement of items	Excessive electrical facilities, lines of old (including extension cords)	Lack of fire-fighting equipment	Lack of monitoring alarm	Undated environmental clean-up	Management organization and lack of staff
2	5	3	0	4	0	4	4	0
5%	12%	7%	0%	9%	0%	9%	9%	0%
10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Undated environmental clean-up	Failure in regularly attending relevant courses or lack of certificates	Insufficient entrances (including those are often closed)	Others (to be repaired, etc.)	Gutters are not smooth	Doors and windows damaged	Pests or ants Road	Increased moisture, wall seepage serious	No significant hazards
0	0	1	7	1	1	2	2	7
0%	0%	2%	16%	2%	2%	5%	5%	16%

To sum up, by the investigation on the hazard indicator of the national CH as follows:

(a) The surroundings is an existed situation, it can be improved by well planning and management.

(b) Private CH has less potential to prepare firefighting and monitoring equipment.

(c) Most CH has been built for a long time. It's not easy to improve their facilities to mitigate the risk without together with the restoration.

(d) Through the effort of management, the substantial improvement is obviously, such as improper items, not tidy environment, and inadequate management together with community relations. It shows that investigating the site regularly will empower site manager to improve the situation of CH.

5. Discussion

Following table statistics, according to building type analysis, temples and mansions for the most hazard, because the relationship between the use of a higher number. In addition, Steles、Gateways、Tombs and Bridges mainly to human factors, because management organization and lack of staff. Risk management and public participation are among the most important issues of those disciplines.

In advance, analysis 18 hazard indicators according to building type as follows:

Table 4. 18 hazard indicators statistical chart for categories

Building Type / Hazard Indicators	Shrine	Temple	Mansion	Inner	Government Office	Station	Academy	Stele	Church	Gateway	Tomb	Lighthouse	Bridge	Industrial facilities	Family dormitory	Other
1(3)		V	V												V	V
2(3)				V										V		V
3(5)	V	V	V		V											V
4(4)	V	V	V													V
5(7)	V	V	V			V	V		V							V
6(9)	V	V	V	V			V		V					V	V	V
7(11)	V	V	V	V			V		V	V	V		V		V	V
8(5)								V		V	V		V			V
9(5)								V		V	V		V			V
10(4)								V		V	V		V			V
11(3)		V	V													V
12(8)	V			V	V			V				V	V	V		V
13(3)			V				V									V
14(2)		V	V													
15(1)		V														
16(2)		V	V													
17(2)		V	V													
18(3)					V	V	V									
Total	32	40	42	3	10	8	6	10	5	8	9	2	15	16	4	152

6. Conclusion

Results found that public CH in Taiwan has done better management. Due to the weakness of management and monitoring mechanism together with less obviously inadequate equipment and insufficient fire-fighting equipment, the hazard indicators of private CH is higher than the public. It is evident that device's setting is still urgently needed for the private CH. The documentation for the maintenance and inspection on the CH is another important issue for the management. Furthermore, for a public usage CH, it should pay particular attention to the internal use of fire and power facilities, the overdue wire (including too many extension) and so on, should be performed periodically

Most hazard indicators of CH can be mitigated mainly by management mechanism such as daily review, scheduled maintain and integrate with appropriated equipment. The cognition and execution of site managers is the key issue for the implementation of disaster management.

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